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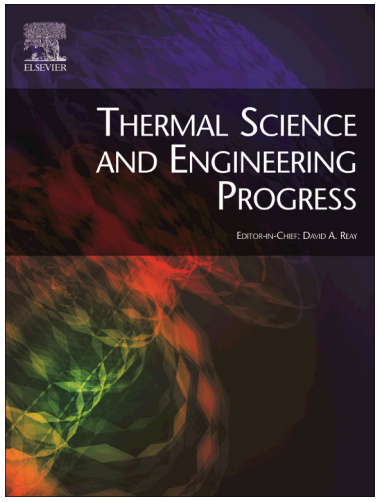

The Thermally-Developing Region in Metal Foam with Open Pores and High Porosity

Nihad Dukhan, Ahmed S. Suleiman

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The Thermally-Developing Region in Metal Foam with Open Pores and High Porosity

Nihad Dukhan (corresponding author) and Ahmed S. Suleiman

Department of Mechanical Engineering

University of Detroit Mercy

4001 W. McNichols Rd., Detroit, MI 48221, USA

Phone:+01 313 993 3285

Fax: +01 313 993 1187

e-mail: ndukhan@att.net

Abstract

The thermal development phenomenon in foam-like conductive porous media, e.g. open-cell metal foam, is investigated via simulation. A typical cell of commercial metal foam was geometrically idealized while maintaining its actual structural features as much as possible. Then, clones of the idealized cell were virtually connected to each other to form a sizable vertical sheet representing a slice of metal foam. This one-cell thick sheet had a length of 33 cells (flow direction) and a height of 15 cells. Because of symmetry, this sheet could represent flow and heat transfer in a semi-infinite metal-foam channel sandwiched between two heated parallel plates separated by a distance twice the sheet's height. The pertinent mass, momentum and heat equations were solved directly at the microscopic level; and the temperature fields were obtained for various approach velocities using a commercial numerical package. The results provided insight into the thermal development region in general, and the thermal entry lengths were determined for air flow at various speeds. The thermally fully-developed Nusselt number was correlated with Reynolds number. To substantiate the results,

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